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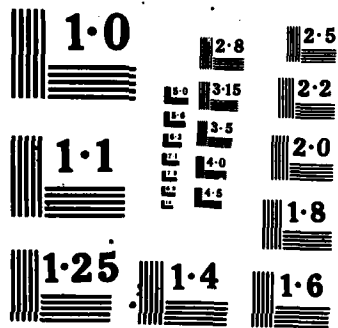
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**RESEARCH AND DEVELOPMENT IN SUPPORT OF THE  
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FINAL REPORT**

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**RESEARCH AND DEVELOPMENT IN SUPPORT OF THE ARMY JOINT OPTICAL  
INFORMATION NETWORK (JOIN): FINAL REPORT**

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## FOREWORD

This report describes research supporting the first large-scale application of computers to the enlisted assessioning process in the United States, the Army Joint Optional Information Network (JOIN) System. It was conducted in accordance with a letter of agreement between Navy Personnel Research and Development Center (NAVPERSRANDCEN) and the Army Research Institute (ARI) for the Behavioral and Social Sciences. This project designed and developed preliminary computerized vocational guidance materials for the JOIN System, and developed computerized screening, assignment prediction, and management support capabilities. One of the most significant accomplishments was the development of the Computerized Adaptive Screening Test (CAST), which became the first-large scale operational use of adaptive testing. JOIN was implemented in September 1984, and is currently in use at 2,200 recruiting stations.

This is the fourth report published under this project. The preceding reports were: Computerized vocational guidance (CVG) systems: Evaluation for use in military recruiting (NPRDC TR 84-21); Designing a vocational guidance system for military recruiting: Problems and prospects. I. Organizational and operational considerations (MPL TN 85-5); and Development of the career maturity assessment (MPL TN 85-7). The results of this project have benefited ARI, the Army Recruiting Command (USAREC), the military personnel research community, and will potentially benefit the recruiting branches of all the armed services.

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Captain, U.S. Navy  
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Technical Director

## SUMMARY

### Problem

Armed forces recruiting faces a serious challenge in the declining 17- to 21-year-old male population and the attendant competition from educational institutions and private sector employers. If the military services are to attract and enlist enough quality applicants to maintain readiness, they must improve the accessioning process.

### Objectives

This report summarizes the research and development accomplished by Navy Personnel Research and Development Center (NAVPERSRANDCEN) in support of the first large-scale application of computers to the recruiting and personnel testing process, the Army Joint Optical Information Network (JOIN) System. Work was performed during FYs 82-84. The specific objectives of the effort reported here were to:

1. Save research and development (R&D) time and dollars by applying expertise developed on the Navy's discontinued Navy Personnel Assessment System (NPAS) to R&D for the Army's JOIN.
2. Acquire, install, and test JOIN developmental, prototype, and operational computer systems for the R&D effort.
3. Design, develop, pilot test, evaluate, and refine (a) computerized applicant screening tests, and (b) automated recruiting management support aids, including automated enlistment kits.
4. Conduct preliminary studies on candidate components of a computerized vocational guidance (CVG) capability for JOIN, including study of the problems associated with introducing vocational guidance into the recruiting environment, and develop, pilot test, evaluate, and refine applicant assessment instruments for the vocational guidance package that Army Research Institute (ARI) will develop for JOIN.
5. Study the feasibility of developing an assignment prediction method for JOIN that will improve the person-job match.
6. Develop a dominant buying motive (DBM) assessment instrument for the JOIN sales package.

### Approach

The approach to the various tasks included literature reviews, test item development, test construction, data collection and analyses, and instrument refinement. Extensive interviews with recruiting managers, automation managers, and recruiters were used, as was the expertise that had been developed at NAVPERSRANDCEN through its work in related R&D areas.

### Results

This 3-year interlaboratory cooperative effort proved very fruitful. Several individual assessment instruments were constructed. One of these, the Computerized

Adaptive Screening Test (CAST), has been implemented as the first large-scale operational use of computerized adaptive testing. Studies critical to the design of recruiting-compatible automated systems were completed and reported to the research and operational communities. JOIN was implemented by the Army in September 1984 and is currently in use at over 2,000 recruiting stations.

Research results for JOIN are discussed by task area. Products and publications are listed in the appendix.

### Conclusions

This project dramatically demonstrated the value of interservice cooperation in leveraging the research dollar. Because recruiting operations are quite similar for all the armed services, the products of this effort have high potential for further technology transfer.



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## INTRODUCTION

### Problem

Armed forces recruiting faces serious challenges in the years ahead due to a declining pool of 17- to 21-year-old males and the attendant increased competition from educational institutions and private sector employers. If the military services are to attract and enlist enough quality applicants to maintain readiness under present and predicted recruiting conditions, they must improve the accessioning process.

### Background

The Army has launched a major, innovative effort to streamline and improve its recruiting and accessioning methods. The Joint Optical Information Network (JOIN) System is in the forefront of this effort (Bryan, 1982). JOIN is a stand-alone microcomputer-based system. In the recruiting process, Army enlisted applicants directly interact with this advanced accessioning system that has been implemented nationwide. The United States Army Recruiting Command (USAREC) is the proponent and developing agency for JOIN. The Army Research Institute (ARI) for the Behavioral and Social Sciences provides research and technical advisory services to USAREC for the JOIN project.

For several years, the Navy Personnel Research and Development Center (NAVPERS-RANDCEN) has been developing prototype automated systems that have applicability to military recruiting (Baker, 1983; 1985b). In particular, the Center produced a demonstration model of a sophisticated computerized system for the Navy Recruiting Command (NAVCRUITCOM)--the Navy Personnel Accessioning System (NPAS)--a system in many respects similar to JOIN (Baker, Rafacz, & Sands, 1983a).

Severe budget cuts for NAVCRUITCOM during FY81 cancelled funding for NPAS for FY82 and the outyears. However, the expertise that had been developed had excellent potential for technology transfer. Accordingly, ARI proposed that the NPAS research team work on the JOIN System under ARI funding. The vehicle for this cooperative effort was an interlaboratory agreement between ARI and NAVPERSRANDCEN, which provided for a 3-year effort beginning in FY82 and terminating on 30 September 1984 (Sands, Gade, & Bryan, 1982).

This report summarizes NAVPERSRANDCEN research and development in support of the JOIN System during FY 82-84.

### Objectives

1. Acquire, install, and test JOIN developmental, prototype, and operational computer systems for the research and development effort.
2. Design, develop, pilot test, evaluate, and refine (a) computerized applicant screening tests, and (b) automated recruiting management support aids, including automated enlistment kits.
3. Conduct preliminary studies on candidate components of a computerized vocational guidance (CVG) capability for JOIN, including study of the problems associated with introducing vocational guidance into the recruiting environment, and develop, pilot test, evaluate, and refine assessment instruments for the vocational guidance package that ARI will develop for JOIN.

4. Study the feasibility of developing an assignment prediction method for JOIN that will improve the person-job match.

5. Develop a dominant buying motive (DBM) assessment instrument for the JOIN sales package.

## **APPROACH**

The approach for accomplishing the research and development by NAVPERSRANDCEN falls into seven related areas:

### **1. Project Management**

We delineated component tasks and assigned task areas to project staff members. In concert with ARI, we established milestones and target dates, together with a system for monitoring progress. We established a JOIN steering committee with the JOIN Project Manager for NAVPERSRANDCEN representing this command. Numerous briefings were conducted for USAREC, ARI, NAVPERSRANDCEN, and other agency personnel. Cost projections were developed and updated periodically. Close coordination was established between NAVPERSRANDCEN, ARI, and USAREC to ensure that the projects developed addressed the needs of Army recruiting.

### **2. Equipment Procurement**

Apple II-Plus microcomputer systems were used as initial developmental and demonstration systems. Equipment acquisition involved preparation of the extensive documentation for computer hardware procurement, including the following: Request for Materials or Services; ADPE Request Data; Acceptance Testing Standards; Maintenance Provisions; ADP and Telecommunications Requirements Checklist; Data Communications Study; and Contract Data Requirements List. Subsequently, JOIN prototype command, control, and communications (C3) systems were used in the research and development efforts. Finally, two JOIN operational computer systems were installed, tested, and used in research and development tasks.

### **3. Aptitude and Adaptability Screening**

This task had two subtasks. The first developed the administration, scoring, and interpretation of a computerized adaptive test for screening Army applicants, the Computerized Adaptive Screening Test (CAST).

Subtask 1. Test items were developed under a NAVPERSRANDCEN contract with the University of Minnesota. Algorithms for item calibration (parameter estimation), adaptive item selection and administration, scoring, and interpretation of the results for subsequent decision-making were developed or adapted from algorithms found in the psychological literature. The interactive computer dialogues for test administration and interpretation were written, edited for correctness, and screened for readability. Computer software for administration, scoring, and interpretation of CAST on a microcomputer system was written in BASIC language; it was tested and demonstrated on computer equipment already at NAVPERSRANDCEN (Baker, 1984a; Baker, Rafacz, & Sands, 1983b).

We later converted the computer programs to the JOIN developmental system (Apple II-Plus) for use in data collection. After field testing (data collection) of the CAST instrument (Sands & Rafacz, 1983), we completed data analyses and instrument refinement. The system for using CAST to predict a person's Armed Forces Qualification Test (AFQT) score was refined and programmed in the BASIC language to operate on the JOIN operational microcomputer C3 system. Complete computer software for administering, scoring, and interpreting the CAST in the operational environment was developed, tested, and documented (Sands & Gade, 1983).

Software modification to permit data collection by ARI in the operational environment was also undertaken and complete software documentation was developed. NAVPERSRANDCEN researchers continued to serve in a consulting role, assisting in program modifications required to interface CAST with the other computer programs in the JOIN System.

Subtask 2. The second subtask of screening development was the investigation of the feasibility of assessing applicant adaptability to military service, and the development of a values-based military adaptability test. The approach included a literature review, item development, instrument construction, pilot testing, interviews, data analyses, and instrument refinement. The contractor's final report served as a deliverable to ARI.

#### 4. Vocational Guidance

Several subtasks were addressed in this area. Literature review and consultation with researchers in the field preceded a study identifying interest and value assessment instruments that might be incorporated into a CVG package. The literature review used both manual and computerized searches.

Contractor efforts provided the design of a preliminary classification of Army entry level occupations by the Holland coding schema (Holland, 1973). Contractors also studied the feasibility of using expressed preferences in a recruiting-oriented CVG system. Their approach included a literature review, interviews with classification specialists, and consultation with experts in the field.

Manual and computerized searches of the literature on CVG systems surveyed available systems, assessed their adaptability to Army purposes, and indicated the type of elements needed in a CVG system for recruiting (Baker, 1984b).

A career maturity assessment instrument (Diamond, 1985) was also developed through literature review, item development, instrument construction, pilot testing, interviews, data analyses, and instrument refinement.

A study of the problems associated with designing a recruiting-compatible vocational guidance system (Baker, 1985a) included a literature review and interviews with military recruiting managers.

#### 5. Recruiting Management Support

Interviews with recruiters and recruiting managers, and previous experience in the field contributed to the needs assessment and development of JOIN capabilities for forms generation, reports generation, and general word processing. Information needed for creating an applicant file of data to produce the Application for Enlistment (DD Form 1966) was determined by isolating those unique data elements represented across all eight

pages of the form. Functional requirements of the computer system that would generate the form were then determined. Because C3 systems were not yet on hand at the time, microcomputer equipment in the inventory at NAVPERSRANDCEN was used to design and develop the software for interactively soliciting data elements from the recruiter preparing the DD Form 1966. Interactive computer dialogues were developed in BASIC language, tested, and demonstrated on a microcomputer system. All software was subjected to system testing, after which extensive documentation of the entire system was completed.

#### 6. Sales Technology

Our interviews with recruiting managers led to selection of the method for assessing enlistment motivation that was already in use in the Army recruiter's sales package as the basis for automated administration of motivation questions. A contract on this subtask included item development, instrument construction, pilot testing, data analyses, and instrument refinement.

#### 7. Personnel Assignment

Interviews with recruiting managers and Army automation managers, and our previously developed expertise helped us assess the developmental efforts needed to interface the JOIN System with the REQUEST the Army's automated schools reservation system, either directly or through the planned Army Recruiting Accession Data System (ARADS). An experience-based in-house study highlighted the problems inherent in developing an assignment-prediction system for Army recruiting.

### RESULTS

Results are discussed below by task area. All products and publications are listed in the appendix.

#### 1. Aptitude and Adaptability Screening

The development of CAST, which was designed to replace the Enlistment Screening Test (a conventionally administered, paper and pencil instrument that predicts an applicant's performance on the AFQT), was a major accomplishment. Complete computer software for using CAST in the operational environment was developed, tested, and documented (Sands & Rafacz, 1983). CAST was implemented nationwide on the JOIN System for screening Army applicants in 1984, thus becoming the first large-scale use of computerized adaptive testing (Sands & Gade, 1983).

A test of military adaptability was also developed under this task area. This instrument would assess adaptability using a values congruence approach, as contrasted with approaches based on empirical biodata and tenure linkages. This effort was undertaken through a contract effort, and the final report, with instrument, was a deliverable to ARI.

#### 2. Vocational Guidance

A review of the literature on available CVG systems and an assessment of their adaptability to Army recruiting was completed. This resulted in a deliverable to ARI, later published as a NAVPERSRANDCEN Technical Report, Computerized vocational

guidance (CVG) systems: Evaluation for use in military recruiting (NPRDC TR 84-21) (Baker, 1984b). The report recommended development of an automated system specifically tailored to military recruiting and accessioning.

Subsequently, work on a conceptual model of a computerized vocational guidance system was initiated. A report detailing the organizational and operational constraints on the design of such a system, Designing a vocational guidance system for use in military recruiting: Problems and prospects. I. Organizational and operational considerations (MPL TN 85-5) (Baker, 1985a), was published by NAVPERSRANDCEN and delivered to ARI.

Working papers were prepared in the areas of interest and values assessment, outlining the many issues, controversies, and available instruments. Efforts to identify a suitable vocational interest inventory for Army recruiting led to recommendations for the Vocational Interest Career Examination (VOICE) (Alley, 1978) as the most suitable.

Additional contract research investigated the feasibility of using expressed preferences in a recruiting-oriented CVG system. Contractor efforts also developed a preliminary classification of Army entry level occupations using the Holland coding schema. The contractor's final report was delivered to ARI.

Another contract effort resulted in an instrument to assess the career maturity of enlistment applicants. This instrument indicates whether the applicant requires more or less guidance in selecting an occupation. It also shows the recruiter the strength of an applicant's job preferences, thereby helping focus the sales interview with applicants whose strongest enlistment motivation is job training. The contractor's final report was delivered to ARI and subsequently published as a NAVPERSRANDCEN Manpower and Personnel Laboratory report, Development of the career maturity assessment (MPL TN 85-7) (Diamond, 1985).

### 3. Recruiting Management Support

Work under this task area developed capabilities for forms generation, reports generation, and general word processing. An automated version of the DD Form 1966 was developed, programmed, and documented. Documentation was delivered to ARI and to USAREC concurrently so that Army automation specialists could begin the task of porting the software to the operational system. An experimental "free-form" automated DD Form 1966 program was also developed at ARI's request, documented, and delivered. Efforts in this task area were curtailed to focus limited personnel resources on screening tests and vocational guidance materials.

### 4. Sales Technology

A contract effort was initiated to develop a test that would help recruiters tailor their sales presentations to individual applicants. This instrument provides a formal technology for using the Army's established sales techniques for determining an applicant's DBM. When implemented, this instrument would determine the strongest motives toward enlistment, allowing the recruiter to quickly focus the sales presentation. The contractor's final report was delivered to ARI.

## 5. Personnel Assignment

Initially, efforts explored procedures for considering the quality of alternative person-job matches through development of an assignment-prediction method. A working paper highlighted the problems inherent in developing an assignment-prediction system for Army recruiting. To provide information on military occupational speciality (MOS) openings, the JOIN System will need to interface with the Army REQUEST system, either directly or through the ARADS. Subsequently, by ARI-NAVPERSRANDCEN agreement and because of delay in linking JOIN to nationwide networks, efforts in this area were suspended in order to concentrate resources on other tasks.

## CONCLUSIONS

This 3-year interlaboratory cooperative effort proved very fruitful. Several new Army applicant assessment instruments were developed, tested, and refined. Studies critical to the design of recruiting-compatible automated systems were completed and their results are now available to the operational and research communities.

The interservice technology transfer of the CAST materially shortened the developmental timeline for an Army computerized prescreening test. This capitalization on extant technology represents a considerable temporal and fiscal savings to the Army, as well as expediting the first large-scale operational use of computerized adaptive testing in the United States.

In sum, the project dramatically demonstrated the value of interservice cooperation in leveraging the research dollar. Because recruiting operations of all the armed services are similar, the products of this effort have high potential for widespread benefit through technology transfer.

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- Sands, W. A., & Rafacz, B. A. (1983, 24-28 October). Computerized adaptive testing (CAT) for the U.S. Army JOIN System. Paper presented at the 25th Annual Conference of the Military Testing Association, Gulf Shores, AL.



**APPENDIX**  
**LIST OF PRODUCTS AND PUBLICATIONS**

## LIST OF PRODUCTS

(Asterisks indicate project deliverables.)

### 1. Project Management

- a. Complete briefing package for NAVPERSRANDCEN R&D in support of the Army Joint Optical Information Network (with visuals).
- b. Complete briefing package for the Computerized Adaptive Screening Test (CAST) (with visuals).
- c. Mini Research and Development Plan (RDMP) for the Joint Optical Information Network (JOIN).
- d. Project Management Plan (PMP) for the Joint Optical Information Network (JOIN).
- e. Work Unit Summary (DD 1498) for the Joint Optical Information Network (JOIN).
- f. Working Paper. Implications of the Privacy Act on a military personnel accessioning system.

### 2. Aptitude and Adaptability Screening

- a. Test Items for CAST.\*
- b. Interactive Dialogue for the CAST.\*
- c. Research Plan and Rationale: Data Collection for the CAST.\*
- d. Program Maintenance Manual for the Computerized Adaptive Screening Test (CAST).\*
- e. User Manual for the Computerized Adaptive Screening Test (CAST).\*
- f. Recruiter's Handbook for the Computerized Adaptive Screening Test (CAST).\*
- g. CAST Data Analyses.\*
- h. ARI-JOIN CAST Data Collection Software.\*
- i. Working Paper. CAST development at NAVPERSRANDCEN.
- j. Working Paper. AFQT score dichotomized by mental group category.
- k. Working Paper. Consequences of applying alternative CAST cutting scores.
- l. Contractor's Report. Development of the Military Adaptability Index.\*

### 3. Recruiting Management Support

- a. Program Documentation for the Computer-based Application for Enlistment (DD Form 1966).\*
- b. Interactive Video Display Terminal Screens for the Automated Application for Enlistment (DD Form 1966).\*
- c. Computer Source Code Listing for the DD 1966 Print Module.\*
- d. Interactive Video Displays for the Computer-based Application for Enlistment (DD Form 1966).\*
- e. Program documentation for the experimental "free-form" automated DD Form 1966.\*

### 4. Vocational Guidance

- a. NAVPERSRANDCEN Technical Report. Computerized vocational guidance (CVG) systems: Evaluation for use in military recruiting.\*
- b. Working Paper. Vocational interests and their assessment in a computerized vocational guidance system.
- c. Working Paper. Vocational values and their assessment.
- d. NAVPERSRANDCEN Technical Report. Computerized vocational guidance (CVG) systems: Evaluation for use in military recruiting.\*
- e. Contractor's Final Report. Development of the career maturity assessment (with instrument).\*
- f. NAVPERSRANDCEN Manpower and Personnel Laboratory Technical Note. Development of the Career Maturity Assessment.
- g. NAVPERSRANDCEN Manpower and Personnel Laboratory Technical Note. Designing a vocational guidance system for military recruiting: Problem and prospects. I. Organizational and operational considerations.\*
- h. Contractor's Report. Preliminary classification of Army entry level occupations by the Holland code.\*
- i. Contractor's Report. The feasibility of using expressions of vocational aspiration in a military vocational guidance system designed for use in recruiting.\*

### 5. Sales Technology

- a. Contractor's Report. Development of the dominant buying motive assessment instrument.\*

### 6. Personnel Assignment

- a. Working Paper. JOIN assignment/reservation prediction system.

## LIST OF PUBLICATIONS

(Includes papers presented at professional meetings)

- Baker, H. G. (1983, 2-6 December). The youthful military job applicant: Perspective on the ante-career crisis. Paper presented at the 77th Annual Convention of the American Vocational Association, Anaheim, CA.
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